

What is claimed is:

1 1. An actuator for moving a driven member, said actuator
2 comprising:
3 a displacement element for producing a specific
4 displacement;
5 a drive member connected to one end of said displacement
6 element and which transfers the displacement of said displacement
7 element to a driven member;
8 a stationary member which supports the other end of the
9 displacement element;
10 a compression member for pressing said drive member against
11 the driven member; and
12 a drive circuit for driving said displacement element such that
13 the drive member and the driven member are in a state of intermittent
14 contact under conditions near the condition of transition from the
15 intermittent contact state to a normal contact state.

1 2. An actuator as claimed in claim 1, wherein a following
2 relationship is satisfied:
3
$$Nt = X0(1/(1/k2 + 1/k3) - 1/(1/k1 + 1/k2 + 1/k3))$$

4 when the spring constant of the compression member is
5 designated $k1$, the combined spring constant of the displacement element
6 and the drive member is designated $k2$, the spring constant of the driven
7 member is designated $k3$, the amount of displacement of the
8 displacement element is designated $X0$, and the compression force
9 applied by the compression member is designated Nt .

1 3. An actuator as claimed in claim 2, wherein said drive circuit
2 drives said displacement element at a resonance frequency.

1 4. An actuator as claimed in claim 1, wherein said drive circuit
2 drives said displacement element at a resonance frequency.

1 5. An actuator as claimed in claim 1, wherein said displace
2 element is a laminate-type piezoelectric element.

1 6. An actuator as claimed in claim 5, wherein said displace
2 element includes alternating layers of a plurality of piezoelectric thin plates
3 and electrodes.

1 7. An actuator for moving a driven member, said actuator
2 comprising:

3 a first displacement element for producing a specific
4 displacement;

5 a second displace element for producing a specific
6 displacement of which direction has a predetermined angle to a direction
7 of the specific direction of said first displacement element;

8 a drive member connected to one ends of said first and
9 second displacement elements and which transfers the displacement of
10 said first and second displacement elements to a driven member;

11 a stationary member which supports the other ends of the first
12 and second displacement elements;

13 a compression member for pressing said drive member against
14 the driven member; and

15 a drive circuit for driving said first and second displacement
16 elements such that the drive member and the driven member are in a

17 state of intermittent contact under conditions near the condition of
18 transition from the intermittent contact state to a normal contact state.

1 8. An actuator as claimed in claim 7, wherein a following
2 relationship is satisfied:

3
$$N_t = X_0 \left(\frac{1}{1/k_2 + 1/k_3} - \frac{1}{1/k_1 + 1/k_2 + 1/k_3} \right)$$

4 when the spring constant of the compression member is
5 designated k_1 , the combined spring constant of the first and second
6 displacement elements and the drive member is designated k_2 , the spring
7 constant of the driven member is designated k_3 , the amount of
8 displacement of the first and second displacement elements is designated
9 X_0 , and the compression force applied by the compression member is
10 designated N_t .

1 9. An actuator as claimed in claim 8, wherein said drive circuit
2 drives said first and second displacement elements at a resonance
3 frequency.

1 10. An actuator as claimed in claim 7, wherein said drive circuit
2 drives said first and second displacement elements at a resonance
3 frequency.

1 11. An actuator as claimed in claim 7, wherein each of said first
2 and second displacement elements is a laminate-type piezoelectric element.

1 12. An actuator as claimed in claim 11, wherein each of said first
2 and second displacement elements includes alternating layers of a plurality of
3 piezoelectric thin plates and electrodes.